Narumi NAKATO*: Cytological studies on the genus *Cyathea* in Japan

中藤成実*: 日本産ヘゴ属の細胞学的研究

Cyathea (sensu Holttum 1963) is a large genus composed of about 600 species distributed in tropics and subtropics. In Japan, eight species are known to occur in southern subtropical areas Taxonomic studies of the Japanese species were reviewed by Iwatsuki (1963), Holttum (1965), Nakaike (1975) and Ohba (1982). Chromosome studies for two of the eight species have been made by Mehra & Singh (1955), Roy & Holttum (1965) and Vasudeva & Bir (1982) using the materials outside Japan. However, the remaining six species have not been examined cytologically yet. In this paper, using Japanese materials, the results of observations of somatic chromosomes are reported for seven species, excluding *C. Tuyamae* H. Ohba.

Materials and methods A list of materials investigated is given in Tab. 1 with the chromosome counts. The voucher specimes are deposited in the National Science Museum, Tokyo (TNS). Root-tips were pretreated with 0.002 M solution of 8-hydroxyquinoline for 3 to 5 hours. They were fixed in 45% acetic acid for about 20 minutes, macerated in a mixed solution of 1N HCl and 45% acetic acid (4:1) for 1 minute at 60°C and squashed in 2% aceto-orcein.

Results and discussion The results of the chromosome observations are summarized in Tab. 1. Five species, i.e. *C. spinulosa*, *C. ogurae*, *C. podophylla*, *C. mertensiana* and *C. lepifera*, are diploid with $2n=138$ ($x=69$). In *C. hancockii*, diploid ($2n=138$) and tetraploid ($2n=c\ 276$) cytotypes are detected. *C. metteniana* is hypo-tetraploid showing $2n=274$. The present record of $2n=138$ in *C. spinulosa* agrees with the previous meiotic count $n=69$ in plants from eastern Himalaya (Mehra & Singh 1955) and central India (Vasudeva & Bir 1982). *C. podophylla* was reported to be $2n=c\ 140$ from southern China (Roy & Holttum 1965). The present observation of $2n=138$ in this species is, therefore, the first confirmation of accurate chromosome number. The chromosome numbers for the other five species are reported here for the first time.

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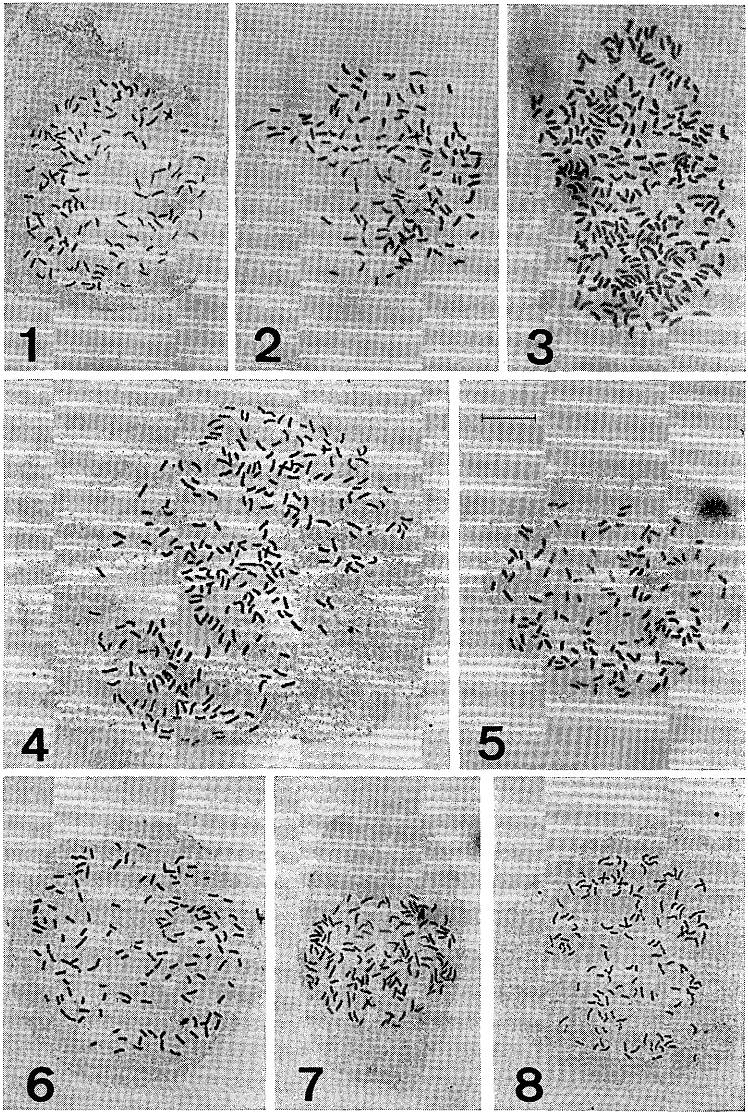
Tab 1. Chromosome numbers and localities of seven Japanese species in the genus *Cyathea*.

Species	Locality (Number of plant examined)	Chromosome number (2n)	Fig.
Cyathea spinulosa Wall. ex Hook.*	Isl. Yakushima, Kagoshima Pref. (2)	138	
	Isl. Amamioshima, Kagoshima Pref. (1)	138	
	Isl. Iriomotejima, Okinawa Pref. (1)	138	1
C hancockii Copel.**	Owase, Mie Pref. (2)	138	2
	Kannoura, Kochi Pref. (1)	c 276	3
	Isl. Okinawajima, Okinawa Pref. (1)	c 138	
C. metteniana (Hance) C. Chr.**	Isl. Ishigakijima, Okinawa Pref. (1)	274	
	Isl. Iriomotejima, Okinawa Pref. (1)	274	4
C. ogurae (Hayata) Domin**	Isl. Chichijima, Tokyo Pref. (1)	138	5
C. podophylla (Hook.) Copel.**	Isl. Ishigakijima, Okinawa Pref (1)	138	
	Isl. Iriomotejima, Okinawa Pref (2)	138	6
C. mertensiana (Kunze) Copel.***	Isl. Chichijima, Tokyo Pref. (1)	138	7
C. lepifera (J. Sm. ex Hook.) Copel.***	Isl. Ishigakijima, Okinawa Pref. (1)	138	
	Isl. Iriomotejima, Okinawa Pref. (2)	138	8

* Subgenus Cyathea, section Cyathea, ** subgen. Cyathea, sect. Gymnosphaera and *** subgenus Sphaeropteris, sect. Sphaeropteris (Holttum 1965).

The chromosomes in each nuclear plate show a gradual variation in length. Based on Figs. 1-8, the length of the longest chromosome to the shortest one are as follows: *C. spinulosa*, 3.0-1.7 μm; *C. hancockii*, 4.4-1.7 μm (2x), 4.2-(0.8?) μm (4x); *C. metteniana*, 3.8-1.5 μm; *C. ogurae*, 3.2-1.4 μm; *C. podophylla*, 3.6-1.3 μm; *C. mertensiana*, 3.5-1.4 μm; *C. lepifera*, 3.0-1.2 μm. The sizes of chromosomes observed here seem to be moderate among ferns. In the tetraploid plant of *C. hancockii*, four exceedingly small fragmental chromosomes (?) of 1.1-0.8 μm in length are found in the nuclear plate (Fig. 3). If these are single chromosomes, the chromosome number is counted as $2n=278$; if these are fragments caused by squash procedure, the chromosome number as $2n=274$-276. More examinations are needed for the determination of accurate chromosome



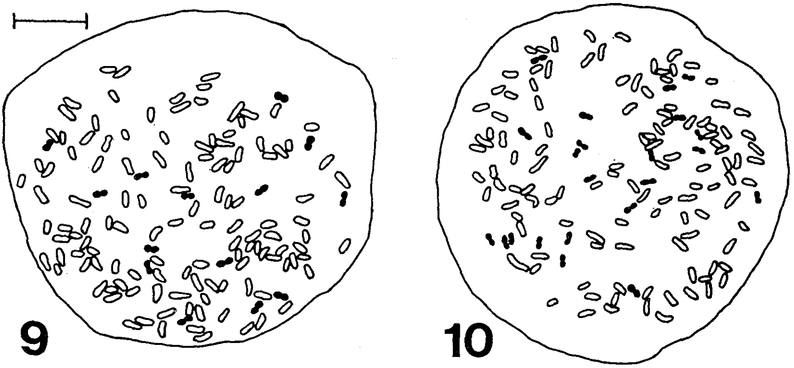
Figs. 1–8. Photomicrographs of somatic chromosomes. 1. *Cyathea spinulosa*, 2n=138. 2. *C. hancockii*, 2n=138. 3. *C. hancockii*, 2n=c 276. 4. *C. metteniana*, 2n=274. 5. *C. ogurae*, 2n=138. 6. *C. podophylla*, 2n=138. 7. *C. mertensiana*, 2n=138. 8. *C. lepifera*, 2n=138. Scale in Fig. 5, 10 μm. All photographs are at the same magnification.

number in this tetraploid *C. hancockii.* The chromosome number of 2n=274 counted in *C. metteniana* is considered to be derived from aneuploid reduction from 2n=276 which is eutetraploid number of x=69.

It is rather difficult to analyze exact karyotypes from the observed nuclear plates, because a considerable number of chromosomes were observed to be a rod shape, lacking clear constrictions. The lack of clear constrictions of chromosomes is partially due to the presence of chromosomes with terminal centromere. However, median chromosomes are often observed. Figs. 9 and 10 show the median chromosomes judged in the nuclear plates of *C. ogurae* and *C. podophylla.* The number of the median chromosomes is at least 14 in *C. ogurae* and 22 in *C. podophylla.* It is noted that all these chromosomes are so small as to be 2.5-1.7 μm in *C. ogurae* and 2.5-1.3 μm in *C. podophylla* In other species, several metacentric chromosomes are also recognized and they are small in size. The number of these chromosomes is at least 10 in *C. spinulosa,* 10 in diploid *C. hancockii,* 16 in tetraploid *C. hancockii,* 14 in *C. metteniana,* 6 in *C. mertensiana* and 14 in *C. lepifera.* The occurence of small-sized metacentric chromosomes may be a common characteristic in *Cyathea.*

The genus *Cyathea* had been considered to be of peculiar cytological features among leptosporangiate ferns, because about 40 species investigated cytologically were constantly diploid showing a high base number of x=69 (Walker 1966, Lovis 1977, etc.) However, in compiling a list of 139 pteridophytes in Taiwan, Tsai & Shieh (1983) reported a tetraploid chromosome number of n=c 138 for the first time in *Cyathea* (*C. fenicis* Copel.) Thus the above cytological consideration was broken down. *C. hancockii* and *C. metteniana* investigated in this study are additional species showing the presence of the polyploid taxa in this genus.

As to Asian species of *Cyathea,* Holttum (1963, 1965) subdivided this genus into two subgenera, Cyathea and Sphaeropteris, on the basis of the difference of stipe scales. According to his classification, *C. fenicis* belongs to subgenus Cyathea, section Cyathea, and *C. hancockii* and *C. metteniana* to subgenus Cyathea, section Gymnosphaera. Thus polyploid species have so far been detected only in subgenus Cyathea. Taiwan and Japan are situated in the northern limit of distribution of the genus *Cyathea.* It is interesting that polyploid species occur in such region.



Figs. 9 & 10. Explanatory diagrams showing small-sized metacentric chromosomes (in black), which correspond to Fig. 5 and 6, respectively. 9. *C. ogurae*, at least 14 such chromosomes are seen. 10. *C. podophylla*, at least 22 such chromosomes are seen. Scale, 10 μm.

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日本産ヘゴ属 7 種の体細胞染色体を観察した。ヘゴ，メヘゴ，クロヘゴ，マルハチ，ヒカゲヘゴの 5 種はすべて 2n=138 の 2 倍体であった。クサマルハチでは 2n=138 の

2倍体と $2n=c\ 276$ の4倍体が観察され，種内倍数性が存在することが判明した。また，チャボヘゴは $2n=274$ を示し低4倍体であった。観察した核板中には，各種とも共通して小型の中部動原体型の染色体がみられた。従来，ヘゴ属には $x=69$ の2倍体のみが知られ，細胞学的に均一であると報告されてきた。しかし，台湾から4倍体種が1種報告されているし，今回もクサマルハチとチャボヘゴで倍数体や異数体が確認された。アジアのヘゴ属は Holttum (1963, 1965) によってさらに Cyathea 亜属と Sphaeropteris 亜属に分類されているが，倍数体種は今のところ Cyathea 亜属のみにみつかっている。

□Sharma, B. M. & P. S. Jamwal: **Flora of upper Lidder Valleys of Kashmir Himalaya, Vol. 1** 269pp. 1988. Scientific Publishers, Jodhpur, India. Rs. 275. 単行本だが，Journ. Economic and Taxonomic Botany の Additional Series No. 4 ということで，雑誌に分類されていたので，見落とすところだった。対象とされているのは，カシミールの中心地スリナガルの東方 50 km にある，5425 m の Kalahoi Peak を主峰とする地域である。この渓谷は巡礼地に通じており，観光客も多く，近年の自然破壊の進行から，緊急な調査の必要に迫られたとされ，本書は1976年から1980年の間の調査の成果である。裸子植物と離弁花類のリストが主体であるが，日本やBMの最近の業績が全く引用されていないのは片手落ちである。 (金井弘夫)

□Munsi, A. H. & G. N. Javeid: **Systematic studies in Polygonaceae of Kashmir Himalaya** 215pp. 1986. Scientific Publishers, Jodhpur, India. Rs. 275 タデ科は特殊なもの以外はそれほど地域分化はないから，ほかのヒマラヤ地域にも使えるだろう。新種や新組合せも散見される。痩果，花粉，表皮パタン，毛も整理されているが，写真の印刷が悪いのは惜しい。 (金井弘夫)

□Stainton, A.: **Flowers of the Himalaya, a supplement** 86 pp., 128 pls. 1988. Oxford Univ. Press, Delhi. Rs 225. さきに刊行された Polunin & Stainton の図鑑の補遺で，462 のカラー写真があらたに示されている。なお前者の写真部分を残して記述部分を半分に縮少した Concice flowers of the Himalaya (283 pp. Rs. 250) もできている。 (金井弘夫)